FIRE SUPPORT

The world military, social and economic environments are changing. Many areas of the world present potentially highly lethal environments wherein the U.S. military may still be expected to react to regional conflicts affecting our strategic interests, succeed quickly and decisively, and do so with minimum casualties.

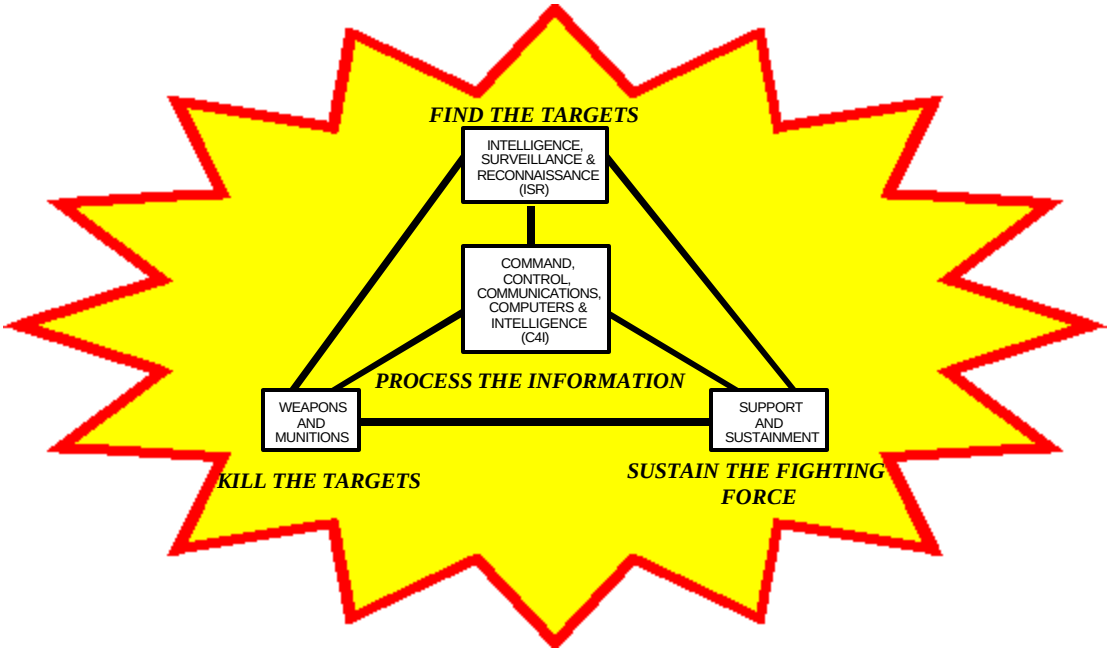
The Army Vision calls for forces that are responsive, deployable, agile, versatile, lethal, survivable, and sustainable. As the Army transforms to achieve this vision, it must maintain and improve existing weapon systems and continue to develop technologies that will provide the basis for forming the Objective Force. Although the U.S. Army will reduce the number of new weapons produced and developed in the foreseeable future, the need to maintain technological superiority will drive scientific and technical efforts to develop new and innovative technologies to overmatch any potential adversary. Integral to the Army's modernization objectives is the need to improve the lethality and survivability of its forces and (implicitly) systems to provide overmatching capability. Fire support systems are an important part of maintaining that overmatch capability.

GENERAL. Fire support is the collective and coordinated use of indirect fire weapons, armed aircraft, and other lethal and nonlethal means in support of a battle plan. Fire support includes mortars, field artillery (FA) weapon systems (howitzers, rockets, and tactical missiles), naval gunfire, and close air support. Nonlethal means are electronic warfare (EW) capabilities of military intelligence organizations, illumination, and smoke. Army maneuver commanders employ these means to support their scheme of

maneuver; to mass firepower and delay, disrupt, or destroy enemy forces in depth. Fire support destroys, neutralizes, and suppresses enemy weapons, enemy formations, and enemy indirect fire systems. The preponderance of fire support available to Army maneuver commanders is provided by FA weapon systems and mortars.

FIRE SUPPORT RESPONSIBILITLIES. Fire support operations have two primary responsibilities. First, they must provide fires in support of maneuver actions and as part of the overall fire support effort. Second, they must provide fire support planning and coordinating resources and facilities at all levels from the maneuver company to the corps.

FIRE SUPPORT SYSTEMS. Effective fire support depends on the close synchronization of the four components of the fire support system: (1) intelligence, surveillance, and reconnaissance (ISR); (2) command, control, communications, computers, and intelligence (C4I); (3) weapons and munitions; and (4) support and sustainment. For each component, the Army has developed systems to facilitate mission accomplishment.

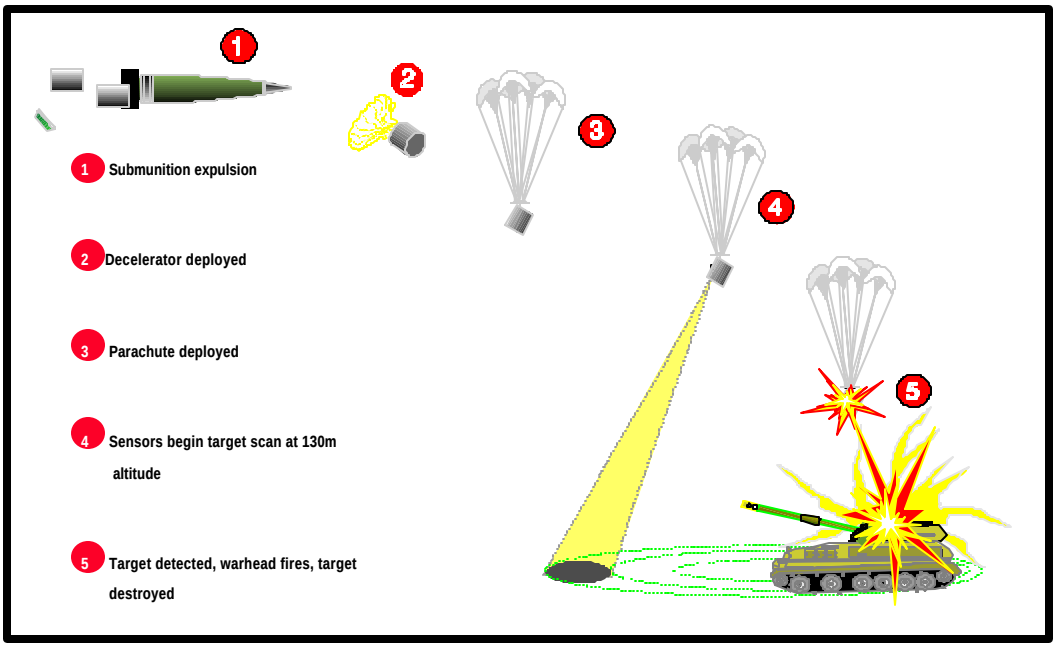


ISR Systems. The primary role of ISR systems in fire support operations is target acquisition—finding the targets. Target acquisition provides the timely detection, identification, and location of targets in sufficient detail to allow their attack. ISR systems that support fire support operations include target acquisition radars, air and ground observers, theater, and even national assets. The field artillery uses the organic division target acquisition battery (TAB) and ground and aerial observers (AOs) and integrates the target-acquiring capabilities of all sources of intelligence to locate targets with sufficient accuracy for attack.

C4I Systems. C4I is the "brain" of the fire support system. This component brings all information together for collation and decision making and provides the technical firing solution for weapon employment. C4I systems supporting fire support operations assist in performing the key functions of tactical fire direction and technical fire direction. Tactical fire direction includes processing calls for fire and determining the appropriate method of fire, ammunition expenditure, unit(s) to fire, and time of attack. Tactical fire direction is conducted based on the commander's guidance and priorities. Technical Fire Direction converts target acquisition information into firing data for a particular weapon system. Often referred to as "gunnery," technical fire direction is performed in fire direction centers of FA cannon batteries, FA cannon battalions, and mortar platoons. Some FA weapon systems have the ability to compute their own firing data.

Weapons and Munitions. Weapons and munitions are the means by which FA executes its missions. They are the very heart of our fire support system. All others exist to support them. FA weapons are classified as cannons and missiles. Cannons are further classified by caliber (diameter of the bore) and by method of transport (towed or self-propelled). Missiles include the subcategory of rockets.

Munitions include cannon and mortar projectiles, rockets, and missiles. These munitions can be further divided into conventional (unguided) and precision munitions. Unguided munitions follow a ballistic trajectory and are generally intended for area targets. Precision munitions are guided after being fired and are intended for point targets, both moving and stationary. "Smart" and "brilliant" munitions are advanced precision munitions that have the ability to detect and engage individual targets with no human intervention after being fired. Precision munitions are cost effective because their pinpoint accuracy provides high assurance of a first-round hit and kill.



Support and Sustainment Systems. Support and sustainment systems ensure we are logistically able to perform the fire support mission. These systems include weapon system prime movers (for towed artillery), ammunition and fuel transport, and general purpose vehicles. Fire Support involves high usage rates of both ammunition and fuel. Additional logistics support includes all classes of supply, maintenance support, recovery, ammunition storage, materiel handling, survey requirements, and meteorological systems.

OPERATIONAL ENVIRONMENT. The operational environment, in which fire support systems are expected to perform now and in the future, is characterized by complex political climates, wide use and exploitation of information technologies, and the availability of advanced weapon systems and equipment. Worldwide contingencies will require the Army to contend with challenging political, cultural, military, and economic aspects within a region. The Army will also have to achieve unity of effort in an

operational environment that will include non military participants, each with competing interests and priorities. The battlefield upon which the Army must operate has and will continue to expand in scale and complexity. Ground forces will find themselves rapidly introduced from strategic distances with potentially little warning. After arrival, they will have to maneuver on and over the ground at great speed, while remaining dispersed to avoid detection and attack. Tactically, adversaries may use low technology to negate high technology. Examples of these techniques include using obscurants to defeat laser-guided weapons, minefields to counter superior mobility, and human shields to protect combatants or key military locations. Fighting in urban areas, where rapid maneuver can be minimized and the close proximity of civilian populations can be leveraged, may militate against using some highly lethal weapon systems. Even with a predisposition toward fighting in urban and complex terrain to maintain sanctuary and negate many current American technological advantages, including precision engagement, potential enemies will likely have unprecedented deep strike capabilities. Regional competitors may use these capabilities to limit U.S. influence by coercing potential U.S. partners or by exercising increasingly effective anti-access/area denial capabilities to threaten strategically important sea and aerial ports or choke points.

The wide range of contingencies facing the Army today and in the foreseeable future requires the Army to be a strategically deployable and responsive force that is dominant at every point across the spectrum of operations—from stability and support to major theaters of war. To effectively support maneuver forces across a wide operational spectrum, Army fire support must be able to rapidly apply lethal and nonlethal effects from the Army, sister services, and non governmental organizations. Compounding the issue, the U.S. may be fighting in conjunction with allies whose organizations, equipment, and doctrine are different. Therefore, any future fire support must remain agile enough to work across the spectrum of capabilities and doctrinal concepts.

THE THREAT. In the context of the expected operational environment, the threats to Army fire support systems include the following:

- Attacks by Tactical Ballistic Missiles (TBMs)
- Cruise Missiles
- Direct and Indirect Fire
- Small Arms/Special Operations Forces (SOF)
- Attack Aircraft and Helicopters
- Artillery and Air Delivered Scatterable Mines
- Nuclear Weapons
- Biological and Chemical Agents
- Enemy Intelligence, Surveillance, and Reconnaissance (ISR)
- Ground Decoys
- Electronic Warfare (EW)
- Anti-Radiation Missiles (ARMs)

Threat Avoidance Categories. Technologies being developed to enhance the survivability of Army fire support systems are grouped into four separate threat

avoidance categories: detection avoidance, hit avoidance, penetration avoidance, and kill avoidance.

1. **Detection Avoidance.** Detection avoidance includes all the technologies and methods used to suppress the sights, sounds, and images naturally associated with fire support systems. Suppressing these signatures so that fire support systems are indistinguishable from their background provides the field artillery with the ultimate advantage of battlefield surprise. Making fire support systems harder to find makes them harder to kill.

2. **Hit Avoidance.** Hit avoidance refers to technologies that mitigate being hit by a weapon after being detected by the enemy. Hit avoidance includes preventing both acquisition by enemy fire control and interception by enemy weapons. Examples of hit avoidance technologies and tactical doctrine are early warning systems, smoke and obscurants, jammers (optics, laser, and radar), decoys (flares and chaff), materials that distort the apparent shape of the equipment, rapid mobility, and counterfire. Furthermore, technologies that enhance our capabilities to exploit the use of terrain and environment through speed and maneuver; the employment of faster, more lethal fire-and-forget counterfire weapons and information systems that contribute to situational awareness also contribute to hit avoidance. Most hit avoidance technologies are integrated into systems in combinations that either deflect, disorient or defeat threats.

3. **Penetration Avoidance**. After being detected and hit, a vehicle must be capable of minimizing and/or preventing penetration in order to survive. Penetration avoidance is accomplished on many systems by using armor that may be active, reactive, or passive. It is also important to note that ballistic protection is not uniform. Inherent in the design of modern combat vehicles is the concept of orienting protection toward where the most significant threats are expected.

4. **Kill Avoidance.** After being detected, hit, and penetrated, a fire support system and its personnel can live to fight another day with the help of kill avoidance technologies. Kill avoidance technologies include nuclear, biological, and chemical (NBC) protection systems; ammunition and fuel compartmentation; fire suppression; spall and nuclear shielding; optics and electronics hardening; and ballistic shock protection. Furthermore, personnel survivability can be enhanced using protective attire.

Fire Support Survivability Enhancement. Survivability is enhanced by technologies that make fire support systems harder to detect, acquire, hit, penetrate, and kill. Based on the sophistication of the threat and the flexibility that our systems must maintain to meet various types of contingencies, no single approach is a panacea. Furthermore, reliance on armor protection to achieve penetration avoidance can reduce the capability to achieve detection avoidance by reducing mobility. The application of survivability technologies involves a complex series of cost and effectiveness tradeoff studies that should result in achievement of enhanced survivability at a reasonable cost, consistent with operational doctrine. The potential of various future fire support systems, system

upgrades, and advanced concepts to enhance survivability is assessed in this context. Figure 1 shows a spectrum of survivability enhancement opportunities. The best approach to survivability is to employ multiple layers of survivability enhancing technologies from the susceptibility and vulnerability reduction categories -- from threat suppression to kill avoidance (left to right on the chart). This allows for combinations that optimize the system's survivability consistent with design constraints. For example, a missile countermeasure device (MCD) might protect against many, but not all, missile threats. The remainder could be defeated by an active protection system (APS). After onboard APS stores run out, or if the system malfunctions, reactive armor would come into play. Survivability enhancement options become more expensive the further along the system is in the acquisition process prior to having them considered in its design. That is why it is important to consider survivability at the earliest stages of a system's design. This is where there will be the most flexibility to conduct trade studies and achieve an optimum solution.

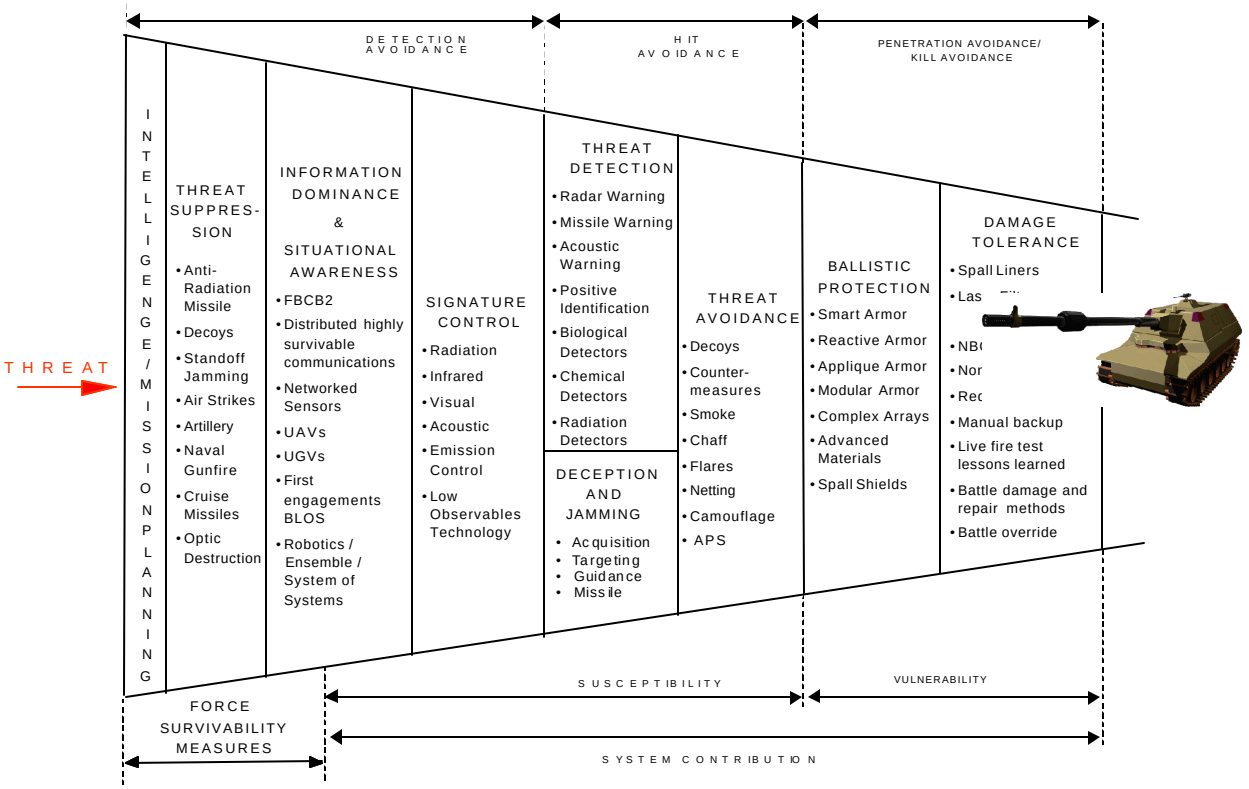


Figure 1. Spectrum of Survivability Enhancement Opportunities.

The Way Ahead. Modernizing Army fire support systems is a continuous, incremental process designed to integrate, package, and provide synergy to system lethality/effectiveness, command and control, mobility, survivability, and sustainment capabilities on the 21st battlefield. With the Army reducing the number of new warfighting systems developed and produced in the foreseeable future, the smaller number of systems deployed to the world's trouble spots must overmatch any potential adversary in terms of lethality, effectiveness, and survivability.

Further Fire Support System Survivability Information. For further information and greater detail on the survivability of U.S. Army fire support weapon systems, please contact the U.S. Army Research Laboratory - Survivability/Lethality Analysis Directorate for access to additional web site information.

The information contained in this document is subject to change at any time. The document should be considered a "living document" and corrections, deletions, updates, and/or corrections are welcomed. All comments should be directed to Mr. Connie Hopper, SLAD, Plans and Programs Manager, WSMR, 505.678.7592, DSN 258.7952, or chopper@arl.army.mil